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Factors that influence the decision to produce exportables in the Chilean agricultural sector

Factores que influyen en la decisión de producir exportables en el sector agrícola chileno

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ABSTRACT

This study analyzes the relative importance of the factors that influence the decision to produce for foreign markets in the Chilean agricultural sector. Using data obtained from personal interviews with 368 farmers, the market/production decision was estimated using a multinomial logit model. Three market/production alternatives were analyzed: production aimed for the external market, production for the internal market but with expectations of being exported, and production targeted only for the internal market. Marginal effects, odds ratios and predicted probabilities were used to identify the relevance of each variable. The results showed that a producer that is male, with a higher educational level, that does not own the land, but rents it, whose farm has irrigation and is located in an area that has a high concentration of exporting producers, will have a high probability of producing exportables. However, the factor that has the highest impact on producing for the external market is the geographic concentration of exporting producers, that is, an export spillover effect. Indeed, when the concentration change from 0 to its maximum (0.26), the odds of producing exportables rather than producing traditional products increases by a factor of 70 (against a factor of 10 in the case of irrigation).

RESUMEN

Este estudio analiza la importancia relativa de los factores que influyen en la decisión de producir para el mercado externo en el sector agrícola chileno. Utilizando datos obtenidos de entrevistas personales aplicadas a 368 agricultores, la decisión de producir para el mercado externo fue estimada con un modelo logístico multinomial. Tres alternativas de producción/mercado fueron analizadas: producción para el mercado externo, producción para el mercado interno pero con expectativas de llegar a exportar y producción enfocada solo al mercado interno. Efectos marginales, razones de posibilidades y probabilidades predichas fueron utilizadas para identificar la relevancia de cada variable. Los resultados muestran que un productor hombre, con un alto nivel educacional, que arrienda la tierra, y cuyo predio tiene riego y está localizado en una zona con una alta concentración de productores de exportables, tendrá altas probabilidades de producir para el mercado externo. Sin embargo, el factor que tiene el mayor impacto en la decisión de producir exportables es la concentración geográfica de los productores de exportables, es decir, hay un fuerte efecto de la difusión de la actividad exportadora. Por cierto, cuando esta concentración cambia de 0 a su valor máximo (0,26), las posibilidades de producir exportables en vez de producir tradicionales aumenta en un factor de 70 (contra un factor de 10 para el caso del riego).

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Keywords

agricultural exports • market-production decision • export decision • multinomial logit model • export spillovers

Palabras clave

exportaciones agrícolas • decisión de producción y mercado • decisión de exportar • modelo logístico multinomial • difusión de la actividad exportadora

INTRODUCTION

Empirical evidence exists showing a positive relation between exports and countries' economic growth (14). As a consequence, firm's decision to produce for foreign markets (the export decision) has been well studied, mainly in the manufacturing industry (3, 29). In general, these studies have found that exporting firms are larger and more capital intensive, pay higher wages, hire more skilled workers, and are more productive than non-exporters. However, research related to the export behavior of firms in other economic areas, such as the primary agricultural sector is scarce. Some studies have been conducted at an aggregated level (1, 11) and others have used farm-level data with a limited set of farmers, products and variables (4).

Importantly, research conducted in this area uses theoretical frame works designed for the manufacturing sector (3, 18). These studies give special emphasis to the role of productivity in the export decision, where in firms of higher productivity have higher probabilities of becoming exporters (23, 33). However, in the agricultural sector there are many factors that affect the export-production decision, mainly due to the complex decision process related to the farmer and the farms (6, 30). Besides, in the Chilean case most farmers do not export directly, but exporting agribusiness firms buy farms' products, make the export decision, and sell the products in foreign markets, which implies that farmers only produce with an "orientation" towards foreign markets (4). There are even farmers that produce exportables without actually exporting them (5). In addition, fruit export-oriented producers, particularly those located in southern Chile, tend to concentrate spatially (4). Hence, the export behavior of farmersseems to correspond to an innovation adoption process, and in that sense, producing exportables are an innovation to be adopted (32). Therefore, studies of farmers' export behavior would be done in the context of an innovation adoption process (31, 32).

Factors used for analyzing the adoption of innovations can be grouped in those related to the farmer, the farm, and the socio-economic and market characteristics associated with the farmer/farm (8, 9). Regarding farmers' personal characteristics, several studies find that younger, higher educated male farmers would be more willing to adopt innovations (6, 28). In addition, the empirical evidence shows that risk-averse farmers are reluctant to introduce innovations (10), and hence, a negative relation would be expected between risk-averse producers and the exportable production. Export behavior models developed for the manufacturing industry also assume that economic agents behave as rational profit maximization units (23). However, in agriculture, farmers do not necessarily maximize profits, but maximize utility, which is a broader concept of the farmer's well-being (6, 24).

The farm-specific characteristics related to the adoption of innovations refer to those variables that are inherently associated with the physical and geographic attributes of the farm, such as the farm size and the presence of irrigation (7).

The socio-economic and market characteristics include factors such as the farmer's perception of neighbors' behavior, the availability of labor, and the market conditions of the productive system (6, 7). Importantly, as an innovation adoption process, the effects that lead to the activity of other exporters in the same area, *i. e.*, the export spillovers effect derived from the agglomeration of farms, are crucial for studying farmers' export behavior (12, 19). Export spillovers can be related to the flow of information from exporting firms or the creation of economies of scales that facilitate the access to foreign markets (20).

Chilean agricultural exports have shown a remarkable growth in recent decades, increasing from US$ 97 million in 1974 to more than US$ 12,400 million in 2011 (26). This progress has gone along with many farmers that have successfully converted to the production of exportables -mainly fresh and processed fruits-. Indeed, in 1997 there were 18,576 farms that produced exportables (farmers with more than 0.5 ha of exportables), while in 2007 these farms increased to 25,127 (15, 16). However, an important share of farms (257,875 in 2007) produced only for the domestic market (17). Interestingly, many farmers that are neighbors (share similar soil type and climate conditions) make different market-production decisions (16). This could indicate that the physical attributes related to farms are less relevant than other variables on this decision (4). Given that a farmer's decision to produce exportables fits well in an innovation adoption process, the hypothesis of this study was that the export spillover effect has a higher effect on the decision to produce exportables. In this context, the objective was to analyze within the Chilean agricultural sector the relative importance of the factors that influence the decision to produce for foreign markets.

MATERIAL AND METHODS

Farms benefit from exporting by increasing their profits, even though exporting also involves extra costs. For example, the production of one hectare of blueberries, a fruit that is mostly exported, requires investments of US$ 23,000 (without considering the cost of land), has annual production costs of US$ 18,000, and generates a margin of US$ 4,950 (with a price to producer of US$ 2.55/kg and a production of 9 tons). On the other hand, the production of one hectare of wheat, a non-export-oriented product, it does not require a long-term investment, has annual costs of US$ 1,250 and generates a margin of around US$ 550 (with a price of US$ 0.30/kg and a production of 6 tons). The same pattern is obtained when other exportables and non-exportables are analyzed. Thus, farmers have an economic incentive to produce exportables, despite the higher investments and costs they require.

In general, the exportables considered in this study are restricted to the group of products that are mainly exported by southern Chilean farmers (as an aggregated), but that do not necessarily are exported by a particular farmer. Besides, for a product to be classified as exportable, its foreign sale price must be directly linked to prices received by farmers who produce them, that is, invoices received by farmers -and derived from sales of the exportable- have to be calculated based on the foreign sale prices. Consequently, farmers should know the sale price in the final market. This excludes products like cheese, where farmersare not involved in the exporting activity. In practice, this definition of "exportables" includes only fruits (mostly raspberries and blueberries). As a consequence, based on the market-production orientation, it is possible to observe three groups of farmers.

The first group ("exporters") corresponds to farmers that produce and sell the exportables, either directly or indirectly through agribusiness exporting firms. That is, they make the decision to produce for the external market. The second group ("transitional producers") includes farmers that produce the exportables, although they do not export them, neither directly nor indirectly. The market for this production is the internal one, and these producers expect to engage in export activity as soon as they reach some minimum level of production and quality required for exporting (this is the case of several raspberry producers). And the third group ("traditional producers") involves farmers whose production is aimed only to the internal market. This group comprises any product that is not classified in the exportable group. In other words, they do not make a decision to produce for the external market.

In this way, the farmer's market-production decision can be modeled through a discrete choice model (22). It is assumed that there are two market-production choices, *A* and *B*. The utility associated with *A* is u_A and the utility associated with *B* is u_B. Farmers choose alternative *A* when $u_A > u_B$ and choose *B* when $u_B > u_A$. Also, it is assumed that $u_B = u_A$ does not occur and that farmers are rational, *i. e.*, they maximize their utility.

When a farmer *i* chooses an alternative *A*, he/she obtains an average utility μ_{iA} and a random error associated with that utility, ε_{iA}.That is, $\mu_{iA} = \mu_{iA} + \varepsilon_{iA}$.The probability that a farmer i will choose the alternative *A* implies that $u_A > u_B$, and therefore:

$$\begin{aligned} Pr(y_i = A) &= Pr(u_{iA} > u_{iB}) \\ &= Pr(\mu_{iA} + \varepsilon_{iA} > \mu_{iB} + \varepsilon_{iB}) \end{aligned}$$

If there are *J* alternatives, the probability that a farmer *i* chooses*m* is:

$$Pr(y_i = m) = Pr(u_{im} > u_{ij} \ \ for \ \ all \ j \neq m)$$

The average utility μ_{iA} is a linear combination of the farmer, the farm and the socio-economic and market characteristics (a vector of *x* variables). That is $\mu_{im} = x_i \beta_m$.

Assuming a logit distribution of the error term, ε, a multinomial logit (MNL) model can be stated as:

$$P(y_i = m | x_i) = \frac{\exp(x_i \beta_m)}{1 + \sum_{j=2}^{J} \exp(x_i \beta_j)}, \quad for \ m > 1$$

where *m* can be any of the three market-production alternatives (exporters, transitional producers or traditional producers).

The variables related to the personal characteristics of the farmers were gender, age, level of education, years of experience in agricultural activities, the ethnic affiliation of the farmer, the perception of the farmer's own risk aversion, and if the farmer has a profit maximization objective. The own farmers' risk perception was captured using a Likert scale, where the producers indicated their own risk perception (risk-averse, risk-neutral and risk-lover), not only regarding their business, but as a perception of their overall risk level. The profit maximization objective variable corresponds to a binary variable where the farmer had to indicate if his/her main objective was to obtain profits (the respective question offered also other potential answers). The farm-specific characteristics included the farm area and the presence of irrigation, defined as the availability of water as well as the water rights owned by farmers. The socio-economic characteristics included the availability of labor and the local export spillover effects. The labor availability variable was calculated as the average of the individual perception of farmers regarding the labor shortage in the specific county where the farm belongs. The export spillover effect was calculated as the number of exporters in a specific county out of the total number of exporters in the sample. In other words, it represents the geographic concentration of farmers that declared to be exporters in a specific county. Other export behavior studies use a similar approach (13, 19). Initially the intention was to include farm productivity; however it was not possible because of the diversity of farm activities and products.

The study considered La Araucanía and Los Ríos regions located between the latitudes 37° 32' 46" S and 40° 26' 27" S and the longitudes 73° 12' 47" W and 71° 51' 46" W. Both regions present a rainy season that extends to all year. For example, Los Ríos region has a rainy climate, that is, there is no a dry season (there are precipitations of more than 40 mm in all months) (2). This climate conditions allow farmers to growth their crops even in the absence of rains, although to obtain high productions of good quality, it is necessary to incorporate irrigation.

Necessary data for analyzing the market-production decision of the three groups of producers was collected. Existing datasets do not provide updated information on the market-production orientation of farmers (*e.g.*, agricultural censuses), or they include a limited set of products and producers that cannot be used in this study (4).

To collect farmer information, a questionnaire was designed to accommodate the answers from the three types of producers. In all cases, the questionnaire included questions that captured information related to variables associated with the farmer, the farm, and the socio-economic characteristics of the farmer/farm. To confirm that no relevant variable was missing, an open question let farmers indicate the main factors they consider to make the decision to produce or not produce exportables.

Although during 2011 agricultural exports account for a 10% of total country exports (around US$ 12,500 million), the number of farmers that exportedwere few (according to the last agricultural census only 5 percent of Chilean farmers export directly or indirectly) (16, 26). As a consequence, a snowball sampling technique was used to identify these types of producers. However, not all farmers were willing to participate in the study. As a result, a representative number of exporters in every county was included in the sample. Then, a set of transitional and traditional producers geographically close to each of the exporters were selected and interviewed. Hence, 368 farmers were interviewed during the first half of 2011.

RESULTS AND DISCUSSION

The production systems of the three groups of producers present several differences. The exporters focused mainly on the production of fruits such as raspberries (75.3%), blueberries (19.1%) and apples (4.5%). The transitional farmers produce export-oriented products (71.1% of raspberries, 2.2% of blueberries, 11.1% of apples and 2.2% of hazelnuts) and internal-market oriented products (potatoes, beans, wheat, barley and those products derived from livestock production). The traditional producers have a mix of both types of products, although they do not have any intention of producing for the external market. Table 1 (page 191) presents a summary with basic statistics for each of the variables for the three types of farmers. In general, exporters are younger, higher educated males, and have less experience in agricultural activities than the other two groups. Also, these producers have larger farms, and the majority has irrigation.

The results of the MNL are presented in table 2 (page 192). The first column presents the estimates using the category "Transitional Producers" as the base category, and the second and third columns use the "Traditional Producers" group as the base category.

Among farmer characteristics, only sex and education show a positive and significant effect on the probability that farmers will choose to be exporters rather than traditional producers. In the case of sex, producers that are males have a higher probability of producing exportable products rather than produce only for the domestic market, and also have a higher probability of producing only exportables rather than producing a mix of exportable and traditional products. Although during the last decades Chilean women have assumed a more active role on the productive decisions of agricultural activities (21), these results show that men have a higher participation than women in the export-production activities. Regarding the effect of education, farmers with more years of education have a higher probability of producing exportable goods. Moreover, producers with high levels of education have a high probability of specializing in the production of exportables. This is consistent with several studies that have found a positive correlation between high skilled workers and export activity (25, 27). However, it is important to note that these studies refer to the educational level of all workers, not just owners, managers or executives whom are assumed to have a high level of education, and that make production or marketing decisions. In the agricultural sector, the educational level of farmers varies enormously. For example, only 14.6% of farmers of the sample have college or university level studies, a 37.8% attended only middle school (less than 8 years of education), and others (1%) never attended school.

Table 1. Descriptive statistics for the three types of producers.
Tabla 1. Estadísticas descriptivas para los tres tipos de productores.

	Traditional Producers (n = 224)			Transitional Producers (n = 46)			Exporters (n = 98)		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Sex	0.527	0	1	0.652	0	1	0.694	0	1
(males=1)	(0.500)			(0.482)			(0.463)		
Age	53.964	19	91	52.457	24	83	48.612	24	90
(years)	(14.413)			(14.385)			(12.013)		
Educational level	8.750	0	17	8.717	0	18	11.133	2	18
(years)	(3.727)			(4.505)			(3.782)		
Experience	30.326	1	70	27.239	2	60	24.107	1	50
(years)	(17.716)			(18.205)			(15.567)		
Indigenous group	0.411	0	1	0.391	0	1	0.378	0	1
(yes=1)	(0.493)			(0.493)			(0.487)		
Profit-maximization	0.353	0	1	0.348	0	1	0.367	0	1
(yes=1)	(0.479)			(0.482)			(0.485)		
Risk-averse	0.344	0	1	0.326	0	1	0.214	0	1
(yes=1)	(0.476)			(0.474)			(0.412)		
Risk-neutral	0.152	0	1	0.152	0	1	0.173	1	1
(yes=1)	(0.360)			(0.363)			(0.381)		
Risk-lover	0.504	0	1	0.522	0	1	0.612	0	1
(yes=1)	(0.501)			(0.505)			(0.490)		
Exportable area				2.440	0	35	6.407	0.3	181
(hectares)				(5.908)			(20.076)		
Farm Area	28.927	0.1	650	29.173	1	480	36.483	0.1	475
(hectares)	(72.394)			(73.128)			(84.290)		
Irrigation	0.286	0	1	0.630	0	1	0.755	0	1
(yes=1)	(0.453)			(0.488)			(0.432)		
Land – owner	0.799	0	1	0.674	0	1	0.765	0	1
(yes=1)	(0.402)			(0.474)			(0.426)		
Land – renter	0.049	0	1	0.130	0	1	0.173	0	1
(yes=1)	(0.217)			(0.341)			(0.381)		
Labor availability*							0.057	0	0.11
(it is a problem =1)							(0.030)		
Export spillovers*							0.066	0	0.26
Index (0 to 1)							(0.076)		

Numbers in parenthesis are standard deviations.
Los números en paréntesis son desviaciones estándar.

*Values are for the entire sample and are an average of all counties.
*Valores para la muestra completa y son un promedio de todas las comunas.

Table 2. Multinomial logit modelresults.
Tabla 2. Resultados del modelo logístico multinomial.

	Exporters (base: Transitional)		Transitional (base: Traditional)		Exporters (base: Traditional)	
Sex	0.310	***	0.867	**	1.177	***
	(0.479)		(0.409)		(0.371)	
Age	-0.016		-0.006		-0.022	
	(0.020)		(0.017)		(0.016)	
Education level	0.188	***	-0.055		0.133	***
	(0.062)		(0.053)		(0.049)	
Profit-maximization goal	-0.095		-0.204		-0.299	
	(0.434)		(0.379)		(0.343)	
Experience	0.010		-0.016		-0.006	
	(0.017)		(0.015)		(0.014)	
Risk-neutral (dummy)	0.513		-0.113		0.400	
	(0.614)		(0.535)		(0.487)	
Risk-lover (dummy)	0.580		-0.156		0.424	
	(0.473)		(0.395)		(0.388)	
Indigenous group	0.316		-0.571		-0.255	
	(0.478)		(0.409)		(0.376)	
Land – owner	0.981		-0.580		0.402	
	(0.640)		(0.473)		(0.550)	
Land – renter	1.064	***	0.422		1.487	**
	(0.812)		(0.706)		(0.723)	
Area	-0.001		0.000		-0.001	
	(0.003)		(0.002)		(0.002)	
Irrigation	0.770	***	1.490	***	2.260	***
	(0.439)		(0.363)		(0.350)	
Export spillovers	11.918	***	4.408		16.326	***
	(4.892)		(4.676)		(3.332)	
Labor availability	1.015		-14.100		-13.085	
	(10.716)		(9.306)		(8.363)	
Intercept	-3.592	***	-0.202		-3.793	***
	(1.532)		(1.249)		(1.247)	
Log likelihood	-248.84					
LR Chi2(28)	175.35					
Pseudo R2	0.2605					

, * significant at 5% and 1%, respectively.
, * significativo al 5% y 1%, respectivamente.

Numbers in parentheses are robust standard errors.
Los números en paréntesis son errores estándares robustos.

It is also interesting to note that the percentage of producers that declared to be profit maximizers is the same for the three groups (table 1, page 191) and hence, in the MNL model this variable does not show to be significant. Moreover, risk-taking farmers do not have a higher probability of producing exportables than those that are risk-averse. This result contrasts with studies that report a negative association between the adoption of innovative crops and risk-averse farmers (8).

Regarding farm-related characteristics, results show that there is a higher probability that farmers will produce for the external market if they rent the land. This result was surprising because export-oriented crops require high investments (*e. g.* irrigation systems, fruit packing plants) which are expected to be executed mainly by farmers that own their land. However, some studies find that the link between landowners and the adoption of innovative crops is not clear (7). This suggests that farmers have serious limitations to buy land or that they have confidence in the returns they will receive from the venture. It is also expected that more capitalized farmers would have a higher probability of engaging in export activities, mainly because these farmers frequently have higher financial resources. Contrastingly, the results showed that farm size is not a relevant variable on the decision to produce exportables. With respect to irrigation, results show that farms with irrigation have higher probabilities of producing exportables, which is consistent with the findings of Echeverria *et al.* (4), that show a positive relation between irrigation and the decision to produce blueberries, an exportable fruit.

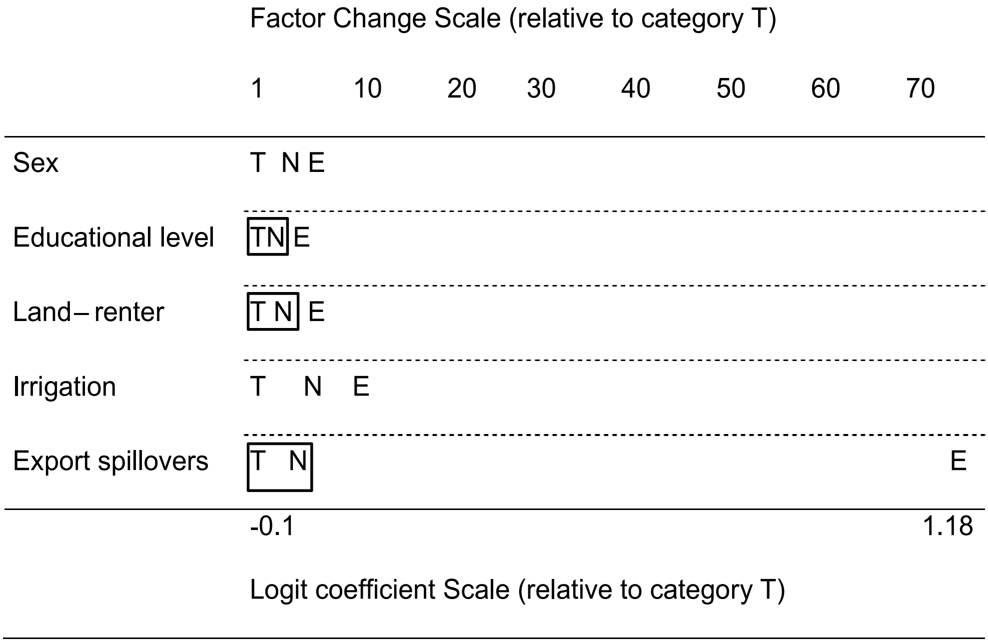
It is important to note that the decision to produce exportables and introduce irrigation in the farm is not the same. According to data, of those farmers that have irrigation, 44.4% produce exportables, 17.4% pretend to export, and 38.2% produce for the internal market. On the other hand, of those farmers that produce exportables, 75.5% has irrigation and 24.5% do not. That is, not all farmers that have irrigation produce exportables, and not all farmers that produce exportables have irrigation, and therefore both decisions are not necessarily tied. It is likely that the climate conditions of the region of study (the rainy season is longer than in the central and north zones) allow to produce the exportable fruits (raspberries, blueberries) without necessarily having irrigation. Of course, with irrigation farmers can improve the quality of the fruit, so they will try to incorporate irrigation as far as possible.

Of the two socio-economic variables, only the export spillover variable was statistically significant. In fact, the results show that when the concentration of export- oriented producers in a specific location (a county in this case) is high, the probability that farmers will produce for the external market is also high (farmers follow other farmers that produce exportables). This is consistent with results of studies conducted in the manufacturing industry (12, 20). It is well known that the geographic concentration of farmers is strongly related to the dissemination of information about the benefits and incentives associated with producing exportable goods (28).

The results obtained from the MNL model provide information on the direction and the significant level of the variables, but not on their magnitude. In order to analyze magnitude, marginal and discrete changes as well as odds ratio plots and predicted probabilities were calculated. Binary variables were analyzed using discrete change from 0 to 1, and continuous variables were analyzed as marginal effects.

Regarding the discrete variables, the effect of irrigation is higher than that of land-renter (0.308 versus 0.280) on the probability of being an exporter. On the other hand, among the continuous variables, the effect of export spillover is higher than that of education. For example, based on the change from the minimum to the maximum value, the probability of being exporter is 0.750 when the concentration of exporters is geographically strong, but it is only 0.372 for a producer that has more years of education.

Besides the marginal and discrete changes, a graphical analysis of odds ratios (factor change coefficients) is presented. This analysis has the advantage of providing information about the magnitude of the factors without considering the value at which each independent variable is analyzed (22). Figure 1 presents odds ratios for the variables that were statistically significant in the MNL model. The letters represent the three alternatives ("exporters", E; "transitional producers", N; and "traditional producers", T). For each variable, the effects on the alternatives that were not significantly different are enclosed in a box. It is clear that export spillover has a greater effect on the probability of being an exporter (a factor change of about 75), followed by irrigation (a factor change of about 10), which confirms the results obtained in the marginal and discrete analysis.



T: Traditional producers; N: Transitional producers; E: Exporters

T: Productores tradicionales; N: Productores transitorios; E: Exportadores

Figure 1. Odd ratios plot derived from the multinomial logit model.
Figura 1. Diagrama de razón de posibilidades derivadas del modelo logístico multinomial.

Taking into consideration that the comparison between variables depends heavily on the nature of the variable (discrete or continuous), a graph with predicted probabilities is used, which allows a comparison between irrigation (the binary variable with the highest marginal effect) and the export spillover index. Figure 2 shows the probability of being an exporter for farmers with and without irrigation, changing the spillover effect index (keeping all other variables at their mean). It is observed that at high levels of the export spillover index, the probability of being an exporter is also high (around 0.9) for farmers with and without irrigation (with a difference of around 0.15). The same probabilities are close to 0.25 when the export spillover index is analyzed at its lower values; however the difference between farmers with and without irrigation is slightly higher (around 0.3). This result suggests that the effect of export spillovers is greater than the effect of irrigation.

Figure 2. Predicted probabilities of producing exportables, comparing the effect of irrigation and export spillovers.
Figura 2. Probabilidades predichas de producir exportables, comparando el efecto del riego y los efectos de la difusión de la actividad exportadora.

The previous results show that the market-production decision in agriculture can be properly modeled as an innovation adoption process, and therefore, further studies on this area should be investigated under this framework (9, 32), and not under export decision models designed for other economic sectors (23, 33).

CONCLUSIONS

Although the decision of producing for the external market is explained by several factors (sex, farmer's educational level, land tenure, presence of irrigation, and the geographic concentration of exporting producers), the factor that has the highest impact on producing for the external market is the geographic concentration of exporting producers, that is, the export spillover effect. Irrigation shows to be the second most important factor on the production decision. This finding is consistent with the hypothesis stated in the study, that the export-production decision in the agricultural sector corresponds to an innovation adoption process, wherein the presence of innovators or early adopters is of great importance for other farmers to make the decision to produce exportables.Thus, policies aimed to promote agricultural exports should focus and encourage the adoption of exportables by some few leaders. In this way, other farmers should follow these leaders, and the spillovers derived from the agglomeration of the export activity would attract even more farmers to produce exportables.

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